EFFECTIVENESS OF WATER HYACINTH (*EICHHORNIA CRASSIPES*) IN TREATMENT OF WASTEWATER AT GEBENG INDUSTRIAL AREA

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Thesis submitted in fulfillment of the requirements
for the award of the
B.Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

First and foremost, thanks to Allah s.w.t for giving me good health and ease all my matter regarding with my study and this research. I am truly grateful and would like to express my sincere thanks and gratitude to my supervisor, Dr. Mir Sujaul Islam for his constant guidance and support in making this research possible. His encouragement has given me the strength and willpower to keep pushing to complete this research. I also sincerely thanks for the time spent in teaching, guiding, and correcting my mistakes.

My most sincere to both my mum Mrs. Sarifah Binti Yaacob and my sister, Nurasyikin Binti Ahmad Zahir for showing me so much love and support to me into the person I am today. I believe their constant prayers for me kept me staying strong especially at times when I felt like giving up. They were my pillars of strength and without the constant support from them, I would not have been able to finish this project on time.

Not to forget, thank you to all of my friends who always help me to finish FYP. I would like to say thank you from the bottom of my heart. Last but not least, I would like to thank everyone whom had contributed either directly or indirectly throughout the process of this research.

ABSTRAK

Pencemaran air merupakan isu yang serius pada masa ini terutamanya sungai, tasik atau kolam berhampiran kawasan perindustrian. Ini adalah kerana air buangan dari industri yang dibuang ke dalamnya selepas beberapa rawatan. Senario ini berbahaya kepada manusia, tetapi juga kepada alam sekitar terutama untuk kehidupan akuatik termasuk tumbuh-tumbuhan dan haiwan. Phytoremediation adalah salah satu alternatif bio-hijau yang boleh merawat air tercemar dengan berkesan. Mekanisme proses ini menggunakan tumbuhan akuatik di mana tumbuhan ini menyerap bahan pencemar dari air dan air menjadi bersih tanpa membahayakan tumbuhan ini. Gondok air (eichhornia crassipes) adalah salah satu tumbuhan akuatik yang menjalani proses phytoremediation secara berkesan termasuk dalam mengeluarkan logam berat seperti plumbum, kadmium dan zink. Kajian ini adalah untuk menentukan keberkesanan air gondok (eichhornia crassipes) dalam rawatan air kumbahan berhampiran perindustrian. Kajian ini dijalankan selama 3 minggu. Kepekatan air sisa adalah 50%, 75% dan 100%. Dari kajian ini, kecekapan penyingkiran tertinggi dalam peratusan selepas 3 minggu untuk BOD (mg / l) adalah 35.78%, COD (mg / l) adalah 62.50%, pH adalah 38.57%, TSS (mg / l) adalah 50%, NH3-N (mg / l) ialah 84.91%, kekeruhan (NTU) adalah 42.34%, Plumbum (mg / l) adalah 70.27%, Kadmium (mg / l) adalah 77.27%, Zinc (mg/l) adalah 83.64%. Walaupun, untuk meningkatkan penyingkiran dalam peratus selepas 3 minggu oksigen terlarut (mg / l) ialah 41.52%. Kecekapan penyingkiran bahan pencemar untuk rawatan lebih berkesan untuk air kumbahan pada kepekatan 50% air kumbahan berbanding 75% dan 100%.

ABSTRACT

Water pollution is a serious issues nowadays especially rivers, lake or pond near the industrial area. This is because of the wastewaters from industry are discharge into it after a few treatments. This scenario is dangerous and harmful to human, but also to environment especially for aquatic life including plants and animals. Phytoremediation is one of bio-green alternatives that can treat polluted water effectively. Mechanism of this process is using aquatic plants where these plants absorb the contaminant from the water and the water become clean without giving harmful to these plants. Water hyacinth (*eichhornia crassipes*) is one of the aquatic plants that undergo phytoremediation process effectively including in removing of heavy metal such as plumbum, cadmium and zinc. This study is to determine the effectiveness of water hyacinth (*eichhornia crassipes*) in treatment of wastewater near industrial. This study was conducted for 3 weeks. The concentrations of wastewater were 50%, 75% and 100%. From this research, the highest removal efficiency in percentage after 3 weeks for BOD (mg/l) was 35.78%, COD (mg/l) was 62.50%, pH was 38.57%, TSS (mg/l) was 50%, NH3-N (mg/l) was 84.91%, turbidity (NTU) was 42.34%, Plumbum (mg/l) is 70.27%, Cadmium (mg/l) was 77.27%, Zinc (mg/l) was 83.64%. While, for increasing removal in percentage after 3 weeks for dissolved oxygen (mg/l) was 41.52%. The removal efficiency of pollutants for treatment was more effective for wastewater at 50% concentration of wastewater compared 75% and 100%.

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LIST OF SYMBOLS

˚c	Degree Celcius
%	Percentage
mg/l	Miligram per litre
L	Litre

LIST OF ABBREVIATIONS

DO	Dissolved Oxygen
NTU	Nephelometric Turbidity Units
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TSS	Total Suspended Solid
NH_3-N	Ammoniacal Nitrogen
Pb	Plumbum
Cd	Cadmium
Zn	Zinc

CHAPTER 1

INTRODUCTION

1.1 Introduction

Water hyacinth (*Eichhornia Crassipes*) is one of the aquatic plants that grow in water and floating without anchorage. As we know, water hyacinth is plants that grow rapidly without proper care on the lakes or ponds. This plant is one of the kinds of plant that grow by it. Even though, water hyacinth present only considered as a worst aquatic weed which can destroy native habitats and effect rates of transpiration, but water hyacinth has bioremediation or phytoremediation property hence has been used for the removal or reduction of nutrient pollutants, heavy metals, organic compounds and pathogens from water (Gopal, 1987).

The plant roots naturally absorb pollutants, including toxic chemicals such as lead and mercury, as well as some organic compounds if the plant was put at industrial wastewater. Industrial wastewater is wastewater that discharged from industrial to the rivers or streams. Type of contaminants and pollutants that are discharge is depends on the type of industrial. This can be affected to the rivers itself which the quality of the water would decrease. As we know, water is essential to all living things including when involved in the human's activities. That's why, a biotechnology way have been introduced to treat this problem. One of it is by using phytoremediation process.

Phytoremediation is the use of plants and associated microorganisms to immobilize (phytostabilization), remove (phytoextraction), evaporate (phytoporation), or degrade (phytodegradation, rhizodegradation) pollutants from soil and environment (A. Placek et al., 2016). As we know, plants act as filters or traps which can break down or degrade organic pollutants or contain and stabilize metal contaminants. For this

process to occur, growing plants has to be put in a contaminated matrix for a required growth period to remove contaminants from the matrix or degradation of the pollutants. At the end, those plants can be subsequently harvested, processed and disposed of in an environmentally proper ways. To sum it up, phytoremediation in aquatic media is directly up take and accumulation of contaminant from water media and assimilation by plants (Ndimele and Ndimele, 2013).

1.2 Problem Statement

Industries are the major sources of pollutions in all environments specifically on water. River systems are the main way for disposal of wastes, especially the wastewater from factories, from industries that are near them. Various levels of pollutants were discharged into the environment according to the type of the industry directly or indirectly through public sewer lines. The common one is wastewater from industries. This wastewater from industries includes employees' sanitary waste, process wastes from manufacturing, wash waters and relatively uncontaminated water from heating and cooling operations. As a consequence, high levels of pollutants in river water systems causes an increase in biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS) and heavy metals, hence make the water unsuitable for drinking, irrigation and aquatic life.

This situation can lead water pollution. As we know, water pollution is a serious problem that we are facing now. This phenomenon has become a global issue. This is because; water is a very essential thing to human mankind including other living organism. In addition of World Water Day 2003, the United Nation Conferences and Development warning that two billions of earth population will die because of water. Furthermore, earth population will experience water shortage by year 2025, if the usage of water is the same rate as today. It is 10 times higher than the death because of war (UNCED, 2003). That's why; phytoremediation was introduced as an alternative way to treat the wastewater.

1.3 Objectives

The objectives of this research are :

i) To determine the pollution status of wastewater at Gebeng Industrial area

ii) To investigate the pollution reduction efficiency of water hyacinth (*eichhornia crassipes*) for removal of pollutant from wastewater.

1.4 Scope of study

Scope of study was determined according to the factor causes of the problem and method of treating the polluted water from any contaminants by using the new alternative and innovative known as phytoremediation. The scope that has been determined is used to aim and potential to achieve the objectives/target of the research.

The scopes of the study are following:

I. Phytoremediation method that using in pollution the wastewater should be doing perform. Thus, the wastewater will be taken from hole that the wastes discharge from factory at industrial area, Gebeng.

II. Experiment will be doing at the experimental laboratory to measure the parameters of the wastewater such as biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, pH value, turbidity, total suspended solid, and heavy metals.

III. The plant has been recognized that using in the phytoremediation method is *eichhornia crassipes*.

REFERENCES

A. Placek, A. Grobelak, M. Kacprzak, (2016). Improving the phytoremediation of heavy metals contaminated soil by use of sewage sludge, Int. J.Phytoremediation 18 :605–618

Abdalla, K.Z. and Hamman, G. (2014). Correlation between Biochemical Oxygen Demand and Chemical Oxygen demand for various wastewater treatment Plants in Egypt to obtain the Biodegradability Indices. International Journal of Sciences: Basic and Applied Research (IJSBAR) 13(1) :42-48

A.M. Paz-Alberto, G.C. Sigua, (2013) Phytoremediation a green technology to remove environmental pollutants, AJCC 2 :71–86

A. Valipour, V.K. Raman, Y. Ahn, (2015) Effectiveness of domestic wastewater treatment using a bio-hedge water hyacinth wetland system, Water 7 :329–347

Bury, S.J., Groot, C.K., Huth, C. and Hardt, N. (2002) Dynamic simulation of chemical industry wastewater treatment plants. Water Science & Technology, Vol. 45 No 4-5 :355-363

Chua H. (1998) ChuaBio-accumulation of environmental residues of rare earth elements in aquatic flora *Eichhornia crassipes* (Mart.) solms in Guangdong province of China Sci. Total Environ., 214 :79-85

Dhir B (2013). Phytoremediation: Role of Aquatic Plants in Environmental Clean-Up. Springer

Gopal, B. (1987). Water Hyacinth Aquatic Plant Studies Series, Elsevier

Gupta, A., Balomajumder, C., (2015) Removal of Cr (VI) and phenol using water hyacinth from single and binary solution in the artificial photosynthesis chamber. J. Water Process Eng. 7 :74-82

Hasan, S.H., Talat, M., Rai, S., (2007) Sorption of cadmium and zinc from aqueoussolutions by water hyacinth (Eichchornia crassipes). Bioresour. Technol. 98 :918-928

H.M. Saleh (2012) Water hyacinth for phytoremediation of radioactive waste simulated contaminated with cesium and cobalt radionuclides, Nucl. Eng. Des. 242 :425–432

J. Vymazal, (2008) Constructed wetlands for wastewater treatment: a review, in: M. Sengupta, R. Dalwani (Eds.), Proceedings of Taal2007, The 12th World Lake Conference 965–980

K. R. Karanth, (1987) Ground Water Assessment: Development and Management, Tata McGraw-Hill Education

Kerr, S.J. (1995) "Silt, Turbidity and Suspended Sediments in the Aquatic Environment: An Annotated Bibliography and Literature Review." Technical Report TR-008. Ontario Ministry of Natural Resources, Southern Region Science and Technology Transfer Unit

Liu, C., Zhao, H., Ma, Z., An, T., Liu, C., Zhao, L., Yong, D., Jia, J., Li, X., and Dong, S. (2014) Novel Environmental Analytical System based on Combined Biodegradation and Photoelectrocatalytic Detection Principles for Rapid Determination of Organic Pollutants in Wastewaters. Environmental Science and Technology 48 :1762-1768

Li, Q., Chen, B., Lin, P., Zhou, J., Zhan, J., Shen, Q., Pan, X., (2016) Adsorption of heavy metal from aqueous solution by dehydrated root powder of long-root Eichhornia crassipes. Int. J. Phytoremediat. 18 :103-109

Manoj Kumar, Avinash Pun, (2012) "A review of permissible limits of drinking water", Indian J. Occup. Environ. Med., Jan-April, 16(1) :40-44

Mishra, V.K., Upadhyaya, A.R., Pandey, S.K., Tripathi, B.D., (2008) Heavy metal pollution induced due to coal mining effluent on surrounding aquatic ecosystem and its management through naturally occurring aquatic macrophytes. Bioresour. Technol. 99 :930-936

Mahamadi, C., Nharingo, T., (2010) Utilization of water hyacinth weed (Eichhornia crassipes) for the removal of Pb(II), Cd(II) and Zn(II) from aquatic environments: an adsorption isotherm study. Environ. Technol. 31 :1221-1228

M.A. Maine, M.V. Duarte, N.L. (2001) SuneCadmium uptake by floating macrophytes Water Res., 35 (11) :2629-2634

Mulbry W, Kondrad S, Pizarro C, Kebede-Westhead E (2008) Treatment of dairy manure effluent using freshwater algae: algal productivity and recovery of manure nutrients using pilot-scale algal turf scrubbers. Bioresource technology, 99(17) :8137-8142

Ndimele P, Ndimele C, (2013) Comparative effects of biostimulation and Phytoremediation on crude oil degradation and absorption by water hyacinth (Eichhornia crassipes [Mart.] Solms). International Journal of Environmental Studies,70 (2) :241-258

P.A.O. Mangabeira, L. Labejof, A. Lamperti, A.A.F. de Almeida, A.H. Oliveira, F. Escaig, M.I.G. Severo, D. Silva, M. Saloes, M.S. Mi elke, E.R.Lucena, M.C. Martinis, K.B. Santana, K.L. Gavrilov, P. Galle, R. (2004) Levi-SettiAccumulation of chromium in root tissues of *Eichhornia crassipes* (Mart.) Solms. in Cachoeira river

P. Moyo, L. Chapungu, B. Mudzengi, (2013) Effectiveness of water hyacinth (Eichhornia crassipes) in remediating polluted water: the case of Shagashe river in Masvingo Zimbabwe, Adv. Appl. Sci. Res. 4 :55–62

R. Sindhu, P. Binod, A. Pandey, A. Madhavan, J.A. Alphonsa, N. Vivek, E. Gnansounou, E. Castro, V. Faraco, (2017) Water hyacinth a potential source for value addition: an overview, Bioresour. Technol. 230 :152–162

Ridzuan MBB, Yeoh DEC, Hung YT (2010) Heavy Metal Removal by Crops from Land Application of Sludge. Environmental Bioengineering, Springer :211-232

So, L. M., Chu, L.M., Wong, P. K. (2003) Microbial enhancement of Cu^{2+} removal capacity of Eichhornia crassipes (Mart.) Chemosphere. 52 :1499-1503

Sim, C.H., (2003) The use of constructed wetlands for wastewater treatment. Water International, Malaysia Office, 24

T. Kösesakal, M. Ünal, O. Kulen, A. Memon, B. Yüksel, (2016) Phytoremediation of pet- roleum hydrocarbons by using a freshwater fern species Azolla filiculoides Lam, Int. J. Phytoremediation 18 :467–476

USEPA (1990) "The Quality of Our Nation's Water: A Summary of the 1988 National Water Quality Inventory." USEPA Office of Water, EPA Report 440/4-90-005, Washington, D.C.

Valittutto, R.S., Silvia, M.S., Emmanoel, V.S., Roberto, G.P., Nobert, M. (2006) Accumulation of metals in macrophytes from water reservoirs of a power supply plant, Rio de Janeiro State, Brazil, Wat. Air Soil Poll. 178 :89-102

Waters, T.F. (1995) "Sediment in Streams: Sources, Biological Effects, and Control." American Fisheries Society Monograph no. 7, American Fisheries Society, Bethesda, MD

Y.-C. Liang, A. Daverey, Y.-T. Huang, S. Sung, J.-G. Lin, (2016) Treatment of semi-conductor wastewater using single-stage partial nitrification and anammox in a pilot-scale reactor, J. Taiwan Inst. Chem. Eng. 63 :236–242

Zhang, Q., Achal, V., Xu, Y., Xiang, W.-N., (2014) Aquaculture wastewater quality improvement by water spinach (Ipomoea aquatica Forsskal) floating bed and ecological benefit assessment in ecological agriculture district. Aquac. Eng. 60 :48-55

Zheng, J., Liu, H., Feng, H., & Li, W. (2016) Competitive sorption of heavy metals by water hyacinth roots. *Environmental Pollution, 219*, 837–845